

caesium, iron and uranium. Materials such as these are commonly found as components of waste and process streams in the nuclear industry.

Consequently, the present invention seeks to provide an efficient method for the removal of such materials, and thereby prevent the severe problems which can otherwise be caused as a consequence of the stubborn nature of the deposits that are formed in pipework, and the subsequent blockages that can be encountered. The method is especially directed towards the removal of deposits which are sufficiently substantial to cause a reduction in the effective internal diameter of a pipe, and thereby have the capability to cause a reduction in the rate of flow of a fluid through the pipework. Additionally, of course, the method is required to be capable of dealing with the more extreme situations wherein severe levels of depositions have occurred, such that a partial or complete blockage of the pipework has already occurred. Clearly, such eventualities can cause severe difficulties, and even lead to catastrophic failures, in industrial processes.

In view of the fact that the method of the present invention finds particular application when dealing with pipeline deposits encountered in the nuclear industry, the potentially toxic nature of the wash liquors which result from the cleaning operation are of obvious concern and it is important that safe, clean and efficient methods of disposal should be available for these waste products. Consequently, the invention also seeks to provide a method of removing these materials from pipework which does not lead to the generation of toxic or harmful waste streams or by-products.

Thus, according to the present invention, there is provided a method for the removal of contaminating materials from pipework, said contaminating materials comprising deposits on the pipework which cause a reduction in the effective internal diameter of the pipes, and thereby effect a reduction in the rate of flow of a fluid through the pipework, the method comprising treating said contaminating materials with at least one carbamate salt.

## CLAIMS

1. A method for the removal of contaminating materials from pipework, said contaminating materials comprising deposits on the pipework which cause a reduction in the effective internal diameter of the pipes and thereby effect a reduction in the rate of flow of a fluid through the pipework, the method comprising treating said contaminating materials with at least one carbamate salt.
2. A method as claimed in claim 1 wherein said contaminating materials comprise partial or total blockages of the pipework.
3. A method as claimed in claim 1 or 2 wherein said carbamate salt comprises an aqueous solution of a carbamate salt.
4. A method as claimed in claim 1, 2 or 3 wherein said carbamate salt comprises ammonium carbamate.
5. A method as claimed in any one of claims 1 to 4 wherein said treatment is carried out at a temperature in the range of from 40°C to 60°C.
6. A method as claimed in claim 5 wherein said temperature is in the region of 60°C.
7. A method as claimed in any preceding claim wherein said treatment is continued for an extended period of time.
8. A method as claimed in claim 7 wherein said treatment is continued for at least 2 hours.

9. A method as claimed in any preceding claim wherein the concentration of said carbamate in aqueous solution is in the range of from 0.3M to 6.0M.
10. A method as claimed in claim 9 wherein said concentration is between 1.0M and 3.0M.
11. A method as claimed in any preceding claim wherein said treatment is carried out in the presence of at least one additive.
12. A method as claimed in claim 11 wherein said additive comprises a carbonate or bicarbonate salt.
13. A method as claimed in claim 12 wherein said carbonate or bicarbonate salt comprises caesium carbonate or ammonium bicarbonate.
14. A method as claimed in any preceding claim wherein said treatment is preceded by pre-treatment with acid and washing with water.
15. A method as claimed in claim 14 wherein said pre-treatment and washing is carried out at room temperature.
16. A method as claimed in any one of claims 1 to 13 wherein said treatment is followed by post-treatment with acid and washing with water.
17. A method as claimed in claim 16 wherein said post-treatment and washing is carried out at room temperature.
18. A method as claimed in any one of claims 14 to 17 wherein said acid comprises nitric acid.

19. A method as claimed in any preceding claim whenever applied to the removal of contaminating materials from pipework in the nuclear processing industry.
- 5 20. A method as claimed in claim 19 which comprises the treatment of pipework used in the processing of Highly Active Liquor with an aqueous solution comprising 0.3-1.0M ammonium carbamate and 0.2M caesium carbonate at 60°C for 2 hours.
- 10 21. A method as claimed in claim 19 which comprises the treatment of pipework used in the processing of Highly Active Liquor as follows:
- (a) treatment with 2.0M nitric acid at room temperature; followed by
  - (b) washing with water at room temperature; followed by
  - 15 (c) treatment with 1.0M or 3.0M aqueous ammonium carbamate solution at 60°C for 2 hours.
- 20 22. A method as claimed in claim 19 which comprises the treatment of pipework used in the processing of Highly Active Liquor as follows:
- (a) Treatment with 1.0M or 3.0M aqueous ammonium carbamate solution at 60°C for 2 hours; followed by
  - 25 (b) Treatment with 2.0M nitric acid at room temperature; followed by
  - (c) Washing with water at room temperature.